

'Lisbon' Lemon Selection Trials in Arizona – 2006-07¹

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Abstract

Four 'Lisbon' lemon selections, 'Frost Nucellar', 'Corona Foothills', 'Limoneira 8A' and 'Prior' were selected for evaluation on Citrus volkameriana rootstock. Yield was extremely low for 2006-07, but these results do not change the fact that that 'Limoneira 8A Lisbon' and 'Corona Foothills Lisbon' are superior to the other two selections tested.

Introduction

There is no disputing the importance of citrus scion cultivar selections to desert citrus production. A successful citrus selection must be adaptable to the harsh climate, (where average high temperatures are often greater than 40°C), must be vigorous and must produce high yields of good quality fruit of marketable size.

Lemons are the most important citrus grown in Arizona today. Today, lemons comprise 60% of all harvested citrus acreage in the state. When the lemon industry was established in the 1950's the principal variety was the 'Desert Lisbon'. No records exist as to the characteristics of this variety. Within a few years however, 'Desert Lisbon' was eclipsed in popularity by 'Frost Nucellar Lisbon' the only nucellar clonal selection of the 'Lisbon' variety. Other popular clonal selections of 'Lisbon' that have been planted in Arizona include 'Monroe', 'Limoneira 8A', 'Prior', and 'Rosenberger'. Popular lemons common to Arizona that are not 'Lisbon' include 'Allen Eureka' and 'Corona Foothills (also known as Foothills)'. All of these represent selections of outstanding trees that were then propagated. All are identified by their originator or place of origin, and are characterized by high vigor, high productivity, precocity (trees bear at an early age), earliness (a high percentage of the fruit can be harvested before 15 November), short thorns and good fruit quality. However, there is a certain amount of variability among lemon clonal selections.

As the Arizona lemon industry has found itself a marketing niche for the late summer and early fall harvest, high productivity, good fruit quality and earliness have become increasingly important. Selections that have not met these standards have been superseded by selections that have these characteristics. Consequently, by 1992, the most popular clonal lemon selection grown in Arizona was the 'Limoneira 8A Lisbon'. This selection originated in Santa Paula, CA, exhibits high productivity, precocity, earliness, and has adequate fruit quality. Other 'Lisbon' selections still grown in Arizona include 'Prior' and 'Frost Nucellar'. 'Corona Foothills' is a more recent introduction that originates in Corona, CA. This selection purportedly originates from 'Villafranca', has fruit that is indistinguishable from 'Eureka', but has a winter distribution of the crop, similar to 'Lisbon'. "Corona Foothills has a reputation for high productivity. Therefore, we planted the first 'Lisbon' lemon selection trial in 1993 including 'Limoneira 8A Lisbon', 'Prior Lisbon', 'Frost Nucellar Lisbon', and 'Corona Foothills Lisbon' lemon on *C. volkameriana* as the rootstock. Previous results from this trial have been reported in previous issues of the Citrus Research Report

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Materials and Methods

This trial was established in March 1993 in Block 26 of the Yuma Mesa Agricultural Center, near Yuma, Arizona. The land was laser leveled and fumigated prior to planting. Trees were planted on a 10-m x 10-m spacing. Ten replicates of each of the 5 rootstocks were planted for a total of 50 trees. Experimental design is randomized complete block.

Irrigation is border flood, and normal cultural practices are used. For several years, leaves were collected annually in August for mineral analysis; however there were no significant differences in leaf nutrient content, so that practice has been stopped.

Yield data is typically collected during the fall and winter. For 2006-07, trees were ring picked just once, on 10-11-06. For that harvest date, the entire yield was estimated by the number of picking sacks harvested per tree. Then, about 70 lbs. per tree of harvested fruit from each tree was passed through an automated electronic eye sorter (Autoline, Inc., Reedley, CA), which provides weight, color, exterior quality and size data for each fruit. Fruit packout data is reported on a percentage basis.

All data was analyzed using SPSS 11.0 for Windows (SPSS Inc., Chicago, Illinois).

Results

Yields for this experiment, since the trees have been bearing, are shown in Figure 1. There have been no consistent trends, however significant differences were found in 1998-99 when 'Limoneira 8A' and 'Corona Foothills', were superior, in 2000-2001 when 'Frost Nucellar' had less yield than the others, in 2002-03 when 'Prior' had less yield than the other selections, in 2003-04 when 'Corona Foothills' had less yield than the others, and in 2004-05 when 'Limoneira 8A' had better yield than all of the others.. Counting only the nine years since 1998-99, when yields of these trees first surpassed 100 lbs per tree, 'Limoneira 8A' has ranked first or second in annual yields eight times (each year except 2002-03), Corona Foothills has ranked first or second seven times (each year except 2003-04 and 2006-07), 'Frost Nucellar' has ranked first or second three times (in 2002-03, 2003-04 and 2006-07), and 'Prior' has ranked first or second only once (2000-01). Since 1998, 'Limoneira 8A' has averaged 380 lbs. of fruit per tree, while 'Corona Foothills' has averaged 360 lbs. of fruit per tree. At our spacing of 30 x 30 feet, this difference corresponds to 16 field boxes per acre. Meanwhile, 'Prior' and 'Frost Nucellar' have averaged 313 and 316 lbs of fruit per tree, respectively.

Yields for the 10-11-06 harvest are shown in Figure 2. Compared to the previous year (Fig. 1), yields for trees on all the selections tested dropped by more than 90%. We attribute this drop as a response to the high yields of the 2005-06 year. It is likely that tree carbohydrate levels were depleted after the 2005-06 year, and could not support a large fruit load for the 2006-07 season. There was no significant differences in yield between the selections tested.

Packout for the harvest is shown in Figure 3. Unlike previous years, there were no significant differences in packout between the selections tested.

There was no difference in fruit shape between the selections (data not shown). There was a distinction in fruit color and exterior quality between the selections (Table 1.). 'Corona Foothills' had significantly more fancy grade fruit (95%), compared with 'Limoneira 8A' (85%), and the other two selections were intermediate. Differences between the percentages of choice and juice fruit between the selections was also evident, with 'Corona Foothills' having less choice and juice fruit than 'Limoneira 8A'. These differences might be due to fruit color. 'Corona Foothills' had significantly greener fruit than the other selections tested.

Discussion and Conclusions

For the selections, both 'Limoneira 8A' and 'Corona Foothills' still appear to be superior to the other selections tested. Yields for 'Limoneira 8A' were the greatest for the first seven years of this twelve-year study. Additionally, first harvest yield is generally greater for this selection, compared to the other selections tested. While for 2001-02 and 2002-03, 'Limoneira 8A' did not have the greatest yield, for 2003-04 and 2004/05, it regained the top spot, fell again into second place in 2005-06, but regained the top spot in 2006-07. Cumulative yield for the 'Limoneira 8A' since planting is about 3540 lbs per tree; the greatest 13-year cumulative yield for all the selections in this trial. Whether 'Limoneira 8A' will remain superior is still not known. Nonetheless, this selection is still the industry standard, and is recommended for planting.

Yield of 'Corona Foothills' has equaled or surpassed 'Limoneira 8A' for four of the past seven years, regaining the top spot in 2005-06 after two years in which it had somewhat lower yield compared to 'Limoneira 8A', but losing the top spot again in 2006-07. Fruit size for this selection was typically to be superior to all others, but this was not the case for the past two years. For five of the first six years of this trial, this selection was inferior to 'Limoneira 8A', and this early inferiority is reflected in the cumulative yield for 'Corona Foothills' of 3270 lbs per tree; about 8% less than 'Limoneira 8A'. Based on its recent performance, this selection is still recommended for planting.

'Frost Nucellar Lisbon' performed well in 2002-03 and 2003-04; the first two years in which it has done so, but then for the next two seasons it fell back again, then regained second position in 2006-07. Before 2002-03, this selection has typically had lower, although not always significantly lower, yield than the other selections tested. Cumulative yield for 'Frost Nucellar' since the inception of this experiment is only 2890 lbs. per tree, about 18% less than 'Limoneira 8A'. Fruit size for 'Frost Nucellar' is typically smaller than 'Corona Foothills' or for 'Limoneira 8A', but there was no difference in 2005/06, or in 2006-07.

After two seasons of superior performance in 2000-01 and in 2001-02, yield of 'Prior Lisbon' was lower from 2002-03, through this year. This marks a return to its lower performance typical of 1994 through 2000. Cumulative yield for this selection since the start of the experiment is 2870 lbs. per tree, about 19% less than 'Limoneira 8A'. While fruit size is often good for this selection, the lower yield cannot be discounted.

Table 1. Fruit color and exterior quality of four lemon selections on *C. volkameriana* rootstock.

Selection	Fruit color ^z	Exterior Fruit Quality (%)		
		Fancy	Choice	Juice
Limoneira 8A	1.975 a ^y	84.96 b	11.33 a	3.71 a
Frost Nucellar	1.952 ab	89.99 ab	7.11 b	2.90 b
Prior	1.875 bc	92.86 a	5.92 b	1.22 b
Corona Foothills	1.831 c	95.45 a	3.27 b	1.28 b

^z Value represents the red to green color ratio of the peel. A larger number indicates a more yellow or orange fruit, while a smaller number indicates a greener fruit.

^y Means separation in columns by Duncan's Multiple Range Test, 5% level

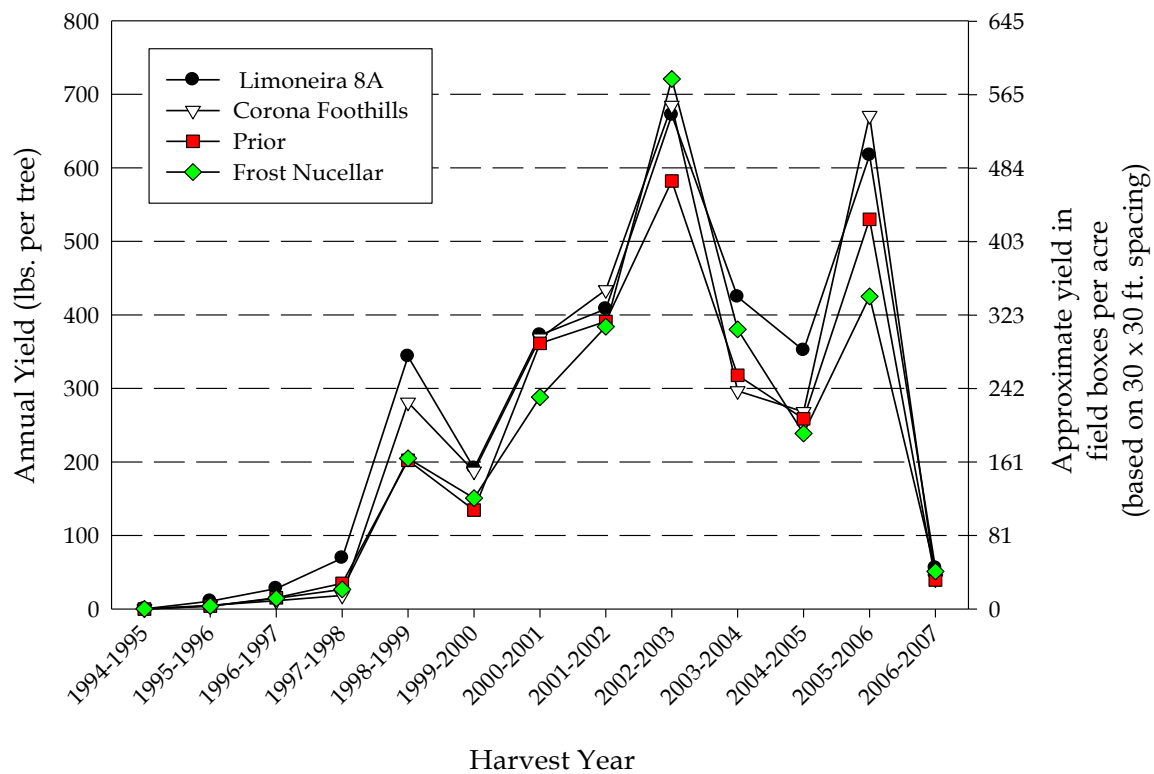


Figure 1. 1994-95 through 2006-07 yields of four 'Lisbon' lemon selections on *C. volkameriana* rootstock.

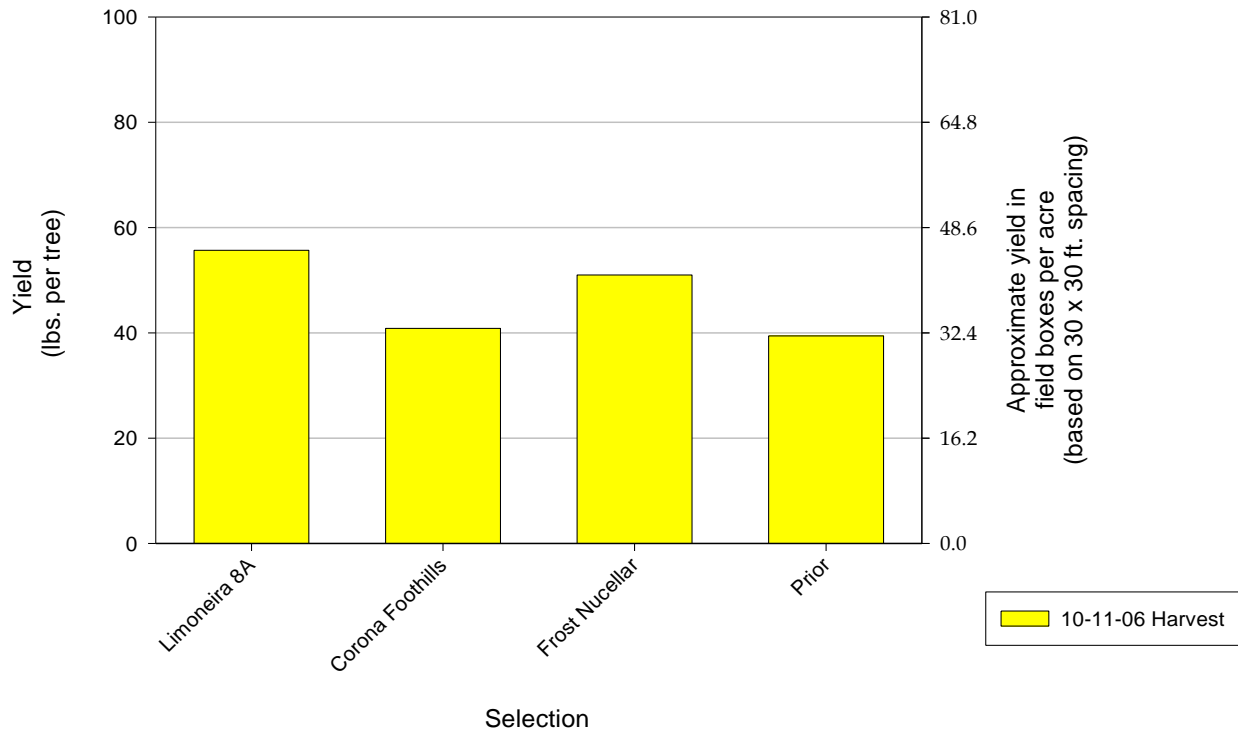


Figure 2. Yields of four 'Lisbon' lemons on *C. volkameriana* rootstocks for 2006-07. There was no significant difference in yield among the selections for 2006-07.

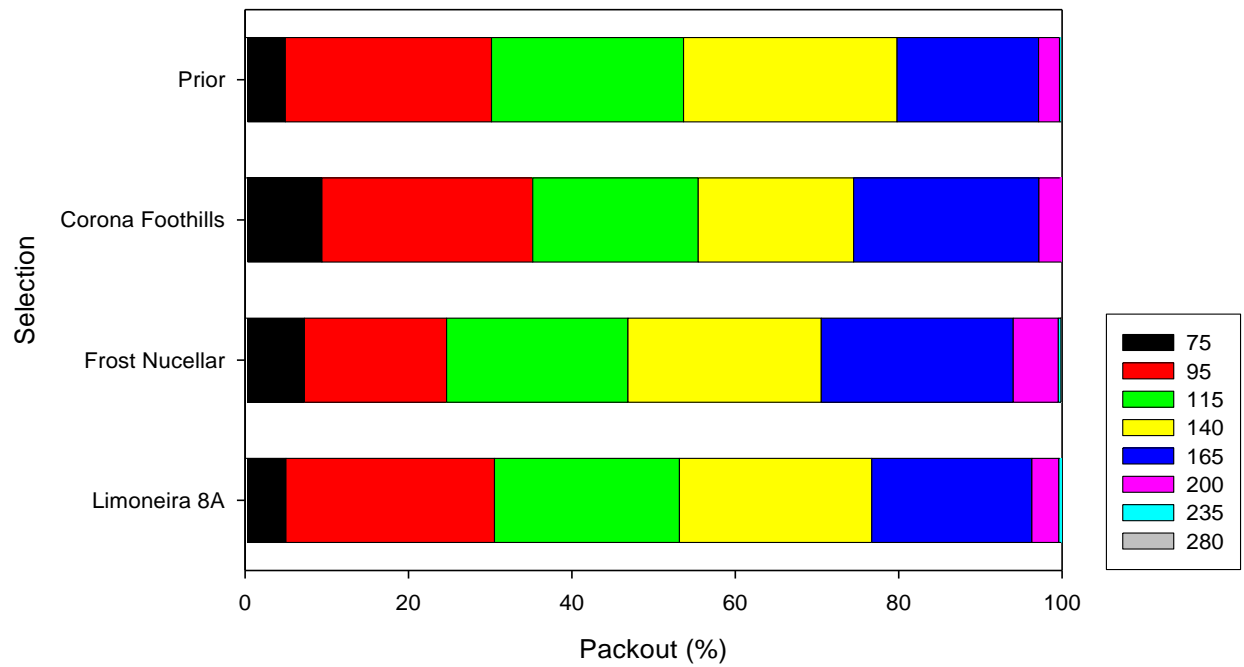


Figure 3. Packout of four 'Lisbon' lemon selections on *C. volkameriana* rootstock for the 10-11-06 harvest. There was no significant effect of the selections upon packout